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NATURE STUDY PRESERVES IN URBAN AREAS

A THESIS

Presented to

The Faculty of the Graduate Division

by

D. Parker Lynch

In Partial Fulfillment

of the Requirements for the Degree

Master of City Planning

Georgia Institute of Technology

December, 1967

NATURE STUDY PRESERVES IN URBAN AREAS

Approved:

Chairman

Date approved by Chairman:

ACKNOWLEDGMENTS

The author acknowledges with gratitude the assistance he has received from his thesis advisor, Professor Malcolm G. Little, Jr., of the Graduate City Planning Program of Georgia Institute of Technology, and of the members of his thesis committee, Professor Howard K. Menhinick of the Graduate City Planning Program of Georgia Institute of Technology, and Dr. Lewis S. Shelton, Jr., Director of Fernbank Science Center, Atlanta, Georgia.

Appreciation is also extended to Miss Natelle Isley and Miss Carolyn L. Robison of the Library of the School of Architecture for their assistance in obtaining reference materials.

The author is especially grateful to the Richard King Mellon Charitable Trusts which provided the financial assistance that made possible this advanced educational experience.

The thesis is dedicated to the author's wife, Betty, and to his two sons, Jerry Lynn and Parker, Jr.

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ABSTRACT

Nature study preserves are tracts of undeveloped land which provide natural environments for the study of nature. The purpose of this thesis is to present information about nature study preserves and to develop guidelines for the establishment of such centers in urban areas.

The need for nature study preserves is being realized more and more by educators, recreationists, and conservationists. The need is particularly acute in urban areas, where many people have little or no contact with the natural world. Yet, in urban areas the loss of natural landscape to buildings, highways, and other urban development limits the availability of suitable sites for nature study areas.

The thesis provides a description of nature study preserves including their educational programs and physical components. It was found that the educational programs embrace a wide range of subjects. However, the fields of nature study, conservation education and research in the natural sciences are most enhanced by nature preserves. The physical components of the nature preserve, which consist of a natural site to which improvements such as nature trails, educational structures, and parking facilities have been added are described.

Guidelines for planning nature study preserves are presented. The first step, the preparation of an educational program, is discussed. Locational considerations for preserves are given. They include site requirements, accessibility to educational institutions, adjoining land use, transportation, and utilities. The principal elements of site

development, which include nature trails, educational structures, and parking facilities are also reviewed.

The responsible agency, staff, and financial assistance for the establishment and operation of nature study preserves are discussed. The administration of nature areas may be the responsibility of public agencies or private organizations. The staff of a typical nature study preserve includes a director, instructors, and secretarial and maintenance personnel. It was found that financial assistance for the establishment and operation of nature study preserves is available from federal and state governments and private sources.

CHAPTER I

INTRODUCTION

A nature study preserve is a tract of undeveloped land utilized for the purpose of advancing the study of natural sciences, including biology and the physical sciences. It is a place where "the citizens of a community, both young and old, can enjoy a segment of the natural world and learn something about the interrelationship of living and non-living things, including man's place in the ecological community."¹

Outdoor education is becoming an important element in the educational curriculum of schools and colleges. Julian W. Smith of the School of Education, Michigan State University, noted:

Only recently have we congregated into cities and formalized our education programs, confining it in classroom walls of brick and mortar. It is a paradox that we now have to open up the classroom doors and use the out-of-doors for those things that can be learned best there. It is encouraging to note that educators are now beginning to realize that many of the things by which people live are related directly to the out-of-doors and particularly to the land. Schools in Michigan and in other places throughout the nation are thinking of parks, recreation areas, forests, and camps as a part of the center of learning.²

Two basic factors contribute to the importance of the early establishment of nature study preserves in urban areas. First, the concentration of the population in urban areas means little or no exposure to the natural world for many people. Second, the loss of the natural landscape to buildings, highways, and other urban development limits the availability of convenient sites for nature study areas in urban

places.

The purpose of this thesis is to provide information on the character of nature study preserves and to develop guidelines for the establishment and operation of such centers in urban areas. Specifically, the educational programs and physical components of nature study preserves are discussed. Planning considerations, including the educational program, locational factors, and site development factors are presented. Also, the administration and finance of nature study preserves are examined. The findings presented here should be of assistance to urban planners, educational officials, and recreational planners in planning for nature study preserves.

Information for this thesis was obtained through the review of available literature, interviews, and correspondence with nature study preserve administrators, educators, and planners. In addition, field investigations were made of three nature study preserves: Fernbank Science Center, DeKalb County, Georgia; Charlotte Children's Nature Museum, Charlotte, North Carolina; and the Nature Study Area of Salisbury, North Carolina.

CHAPTER II

NATURE STUDY PRESERVES

It has been estimated that there are at least 200 nature study preserves in the United States and Canada with approximately one-half administered by public agencies and one-half administered by private or semi-private organizations³. The Natural Science for Youth Foundation^{*} published a directory of natural science centers, nature museums, and trailside museums in 1965 which listed 185 establishments in thirty states and the District of Columbia⁴. (See Appendix I for a compilation of these by states.)

Nature study preserves vary greatly in their educational programs and physical components. The educational programs of nature study areas range from limited programs with self-guiding trails to extensive educational programs with specialized instruction in the natural phenomena of the preserve, conservation, astronomy, and the like. Sites for nature study preserves range in size from a few acres to hundreds of acres. Site improvements may be limited to nature trails through the preserves or may include extensive educational structures and on-site parking facilities.

Consequently, the capital outlays and annual operating costs of nature study preserves vary greatly. The western representatives for

^{*} Natural Science for Youth Foundation, 114 East 30th Street, New York 16, New York.

the National Audubon Society^{*}, Mr. William Goodall, notes that the capital outlays for land and structures may range from \$30,000 to \$300,000, and annual operating costs may range from \$15,000 to \$150,000⁵. However, Fernbank Science Center in Atlanta, Georgia, recently completed an educational structure costing approximately \$850,000. Nature trail development on the fifty-acre natural site, which is leased to the DeKalb County Board of Education for a nominal fee, is costing \$100,000. The annual operating budget with a staff of forty-three persons is about \$500,000⁶.

At the other end of the spectrum, Big Cypress Center in Naples, Florida, operates a seasonal educational program on an annual budget of less than \$15,000. Its educational structure, formerly a fourteen-room beach house, and the land were donated for nature study⁷. Another preserve, Mid-Fairfield County Youth Museum in Westport, Connecticut, had an initial capital outlay of \$350,000 and an annual operating budget of \$45,000 in 1962⁸.

This chapter discusses the educational programs and physical components of nature study preserves.

Educational Programs

The educational programs of nature study preserves are designed to advance the teaching of natural phenomena through the use of outdoor classrooms. The importance of using the out-of-doors for educational purposes is noted by L. B. Sharp:

* National Audubon Society, 1130 Fifth Avenue, New York, N. Y. 10028.

Outdoor education is a common sense method of learning. It is natural; it is plain, direct and simple. The principal thesis which underlies the implications of outdoor education for all subject matter in all areas of study, and at all levels: That which can best be learned inside the classroom should be learned there. That which can best be learned in the out-of-doors through direct experience, dealing with native materials and life situations, should there be learned⁹.

Another educator has said: "Outdoor education has assumed an ever increasing importance until today it stands as one of the most significant developments in education."¹⁰ Nature study preserves provide educational opportunities not afforded in the schoolrooms of the urban areas.

Part of the education of urban children should take place in rural settings. City life is very artificial. Milk comes in bottles. Pieces of paper are the medium of exchange. There are many possibilities for education in a large city, but man grievously needs to have a chance to make contact somewhere with the good earth from which he sprang. He cannot forever deny this heritage. In the country, life springs up all around. The mysteries of the earth itself, of plant and animal husbandry, of procreation and of decay, teach the lessons of life as no city pavement can do¹¹.

The educational programs of nature study preserves take many forms. For example, the educational program at the Nature Study Area of Salisbury, North Carolina, includes nature study and natural sciences, space age science, fine arts (visual), and local and regional history. (See Appendix II for details of the program.) The program on history relates, in part, to the availability on the preserve site of a one-room log school house dating from 1842 and an ore mill used in the 19th century for mining gold. The space science program will be made possible by a proposed space science laboratory¹².

The educational program of Fernbank Science Center encompasses natural science, natural history, astronomy, meteorology, and geology. An extensive program of nature study, including plant taxonomy, field

ecology, forest succession, ornithology, and conservation, is conducted in the forest preserve¹³. (See Appendix III for curriculum outlines.)

Educational programs of nature study preserves are usually supplementary to regular curricular courses taught in the classrooms, especially when administered by school systems. They embrace a wide range of subjects, consisting basically of three principal elements: nature study, conservation education, and research.

Nature Study

The study of nature afforded by preserves differs from a typical natural science course. Natural science courses are usually taught in a systematic manner. Biology begins with the simplest forms of life and progresses logically to the highest forms of life. In contrast, nature study programs of preserves give the student an over-view of all natural phenomena in the nature study area¹⁴. Anna Botsford Comstock, late professor of nature-study at Cornell University, said: "Nature-study is for the comprehension of the individual life of the bird, insect, or plant that is nearest at hand."¹⁵

Nature study programs include the interpretation of both living and non-living aspects of nature. They stress the interrelationships between animals, plants, and other physical features such as soil and water.

Zoology. Both land and water animals are usually available in nature study preserves. The species at a particular preserve depend upon the environmental conditions of the area such as topography, soil, water, temperature, winds, and season. Birds, fish, amphibians, reptiles, mammals, and invertebrate animals of various species are usually found in

nature study preserves. Not only are the animals observed, but the habitat, tracks, and works of the animals can be investigated for greater insight into nature. For example, a beaver dam is a very interesting aspect of animal life.

Botany. Plants, including wild flowers, weeds, trees, and flowerless plants, are found and studied at nature study preserves. As with animals, the environmental conditions determine the presence of certain plant species. The plants are identified and their habitat evaluated in nature study programs.

Geology. The physical features of the earth, such as rocks, minerals, soil, and water are other elements of nature study. Soil pits showing the different layers of soil, lakes, branches, and rock outcrops are elements frequently provided by nature study preserves for the study of natural physical features.

Others. Other subjects, while not dependent upon nature preserves, are included in nature study programs. Astronomy and meteorology are such topics and are frequently taught at preserves¹⁶.

A number of preserves provide instruction in astronomy through the use of on-site planetariums or observatories. In fact, Fernbank Science Center in Metropolitan Atlanta offers an extensive program in astronomy¹⁷.

Instruction in meteorology is possible through the use of weather stations. Brookside Nature Center, Wheaton, Maryland, has such a weather station and provides for the study of the atmosphere and climate.

Conservation Education

Programs of conservation education are designed to promote the

conservation of natural resources. "It is said that attitudes stem from knowledge, and that knowledge begets understanding, which in turn generates interest. When knowledge, understanding, and interest develop, then one sees the emergence of the good conservation attitudes"18

Through the observation of conservation demonstrations at nature study preserves, the participant is made aware of his role as steward of the natural resources.

The Nature Centers Division of the National Audubon Society recommends that conservation education programs stress the following general conservation principles:

1. Conservation denotes more than wise natural resources use. It also includes a way of thinking and acting, and a way of life. In other words, conservation includes techniques of both land and water management as well as a code of conduct.
2. Man gives meaning and importance to natural resources. Iron, for example, was not a natural resource until it was discovered and used by man.
3. The basic renewable natural resources, from one practical viewpoint, are soil, water, plants, and animals. Minerals and fossil fuels are considered a nonrenewable natural resource. Air, space, and sunlight are also resources, as are scenic landscapes and other esthetic attractions.
4. All natural resources are related and interdependent. Man cannot survive without them.
5. The strength of the mind, body, and spirit is rooted deeply in nature and the land.
6. For America to remain a strong and vigorous nation it must have a strong natural resources base.¹⁹

While nature study programs tend to foster an appreciation of the outdoors and natural resources, conservation programs place emphasis on the conservation of soil, water, plant, and wildlife. To illustrate, High Rock Nature Conservation Center in the central section of Staten

Island, New York, is not only preserving existing plants and animals, but attempting to re-establish species known to have been found in the area, but not now present²⁰.

The Arizona-Sonora Desert Museum, a nature study area on the outskirts of Tucson, Arizona, promotes water conservation by a watershed exposition. The exposition demonstrates how conservation practices can control floods and retain rainwater for use in arid regions²¹.

Soil conservation, forestry, and wildlife management demonstration areas are advocated by the National Audubon Society for conservation education facilities²². Basic principles such as the importance of a cover crop in the prevention of soil erosion, the importance of forest harvesting in the production of timber, and the importance of food and water in the survival of wild animals, are contained in conservation programs of this type.

Research

Nature study preserves provide outdoor laboratories for research in the biological and physical sciences by interested persons. The continuity of natural conditions provided at nature study preserves can be a real asset to research involving natural science. While none of the nature study preserves reviewed actually had programs of research, Fernbank Science Center of Atlanta, Georgia, proposes the inclusion of experimental work for exceptional students in their future educational program²³.

Physical Components

The physical components of nature study preserves consist of the site and improvements such as nature trails, educational structures, and

parking facilities. (See Figure 1.)

Site

The site is the basic component of a nature study preserve. The geologic and hydrographic features of the land support plant and animal life. The cover and the inhabitants of the preserve site provide the natural environment required for the educational program.

The area of nature preserve sites range from less than fifty acres to hundreds of acres. To illustrate, the Nature Study Area of Salisbury, North Carolina, embraces approximately thirty acres; the Mid-Fairfield County Youth Museum of Westport, Connecticut, contains fifty-one acres; the Audubon Center of Southern California in El Monte, California, embraces one hundred and twenty-seven acres; and the Arizona-Sonora Desert Museum near Tucson, Arizona, involves one thousand five hundred acres²⁴.

Improvements

The physical improvements of nature study preserves include nature trails, educational structures, and parking facilities.

Nature Trails. Nature trails are paths through nature study preserves which provide the visitor an opportunity to observe the features of the area in their natural setting. Outdoor teaching stations and outdoor demonstration areas are frequently located along nature trails. Teaching stations provide space for visitors to assemble while the instructor briefs them on pertinent aspects of nature study. Outdoor demonstration areas aid visitors in the interpretation of the natural phenomena of the preserve. Devices used in the demonstration areas include botany pools, tree stumps cut to show the annual rings of growth, turtle

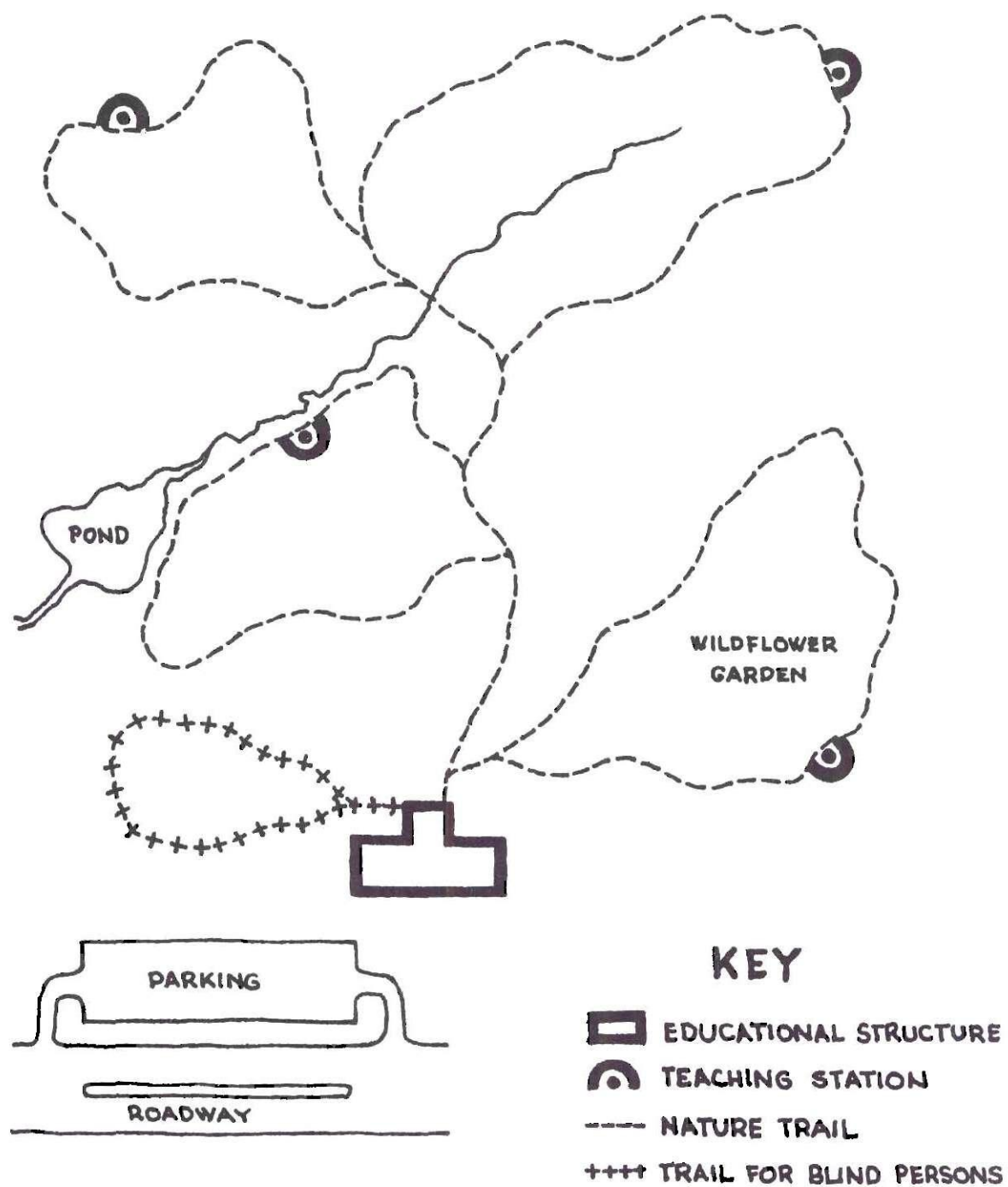


Figure 1. Sketch of Nature Study Preserve

ponds, bird feeders, soil pits, and geology walls. Other teaching devices include sundials, weather stations, observation towers, and elevated walkways over low lying areas²⁵.

There are many kinds of nature trails, and nature specialists have not universally adopted a classification system. However, the National Audubon Society has suggested three categories, namely, general trails, subject trails, and special-use trails²⁶.

General Trails. General trails begin and end near educational structures and circulate through an area containing features of interest such as geologic formations, wild flowers, animal habitats, woods, and other natural features of the landscape. Usually no effort is made to develop a story or show the interrelationship between the features. Mangrove Trail in Big Cypress Center, Naples, Florida, with its live oak and slash pine trees, numerous plants, animal homes including woodpecker holes, the Gordon River, and a mangrove swamp, is an example of a general nature trail²⁷. In small nature study areas, general purpose trails may be the only trails available.

Subject Trails. Subject trails are trails of specialization. Specific natural features or conservation are emphasized along these trails in a systematic manner by developing a theme or by telling a story. Subject trails are usually found in large nature study preserves and have the advantage of serving the needs of special interest groups or individuals. For example, subject trails on animal habitat provide the trail walker with a view of numerous animal habitats including perhaps bird nests, ant hills, bee hives, and squirrel dens²⁸.

Special-use Trails. Special-use trails are designed to accommodate

particular modes of travel or different types of users. The subject matter of these trails may be general or specialized. Bicycle trails, boat trails, and horseback riding trails are developed to accommodate a particular mode of travel. These trails eliminate the conflict between the various modes of travel, such as between bicyclists and pedestrians. In the case of boat trails, access to nature by water rather than by the typical land approach is provided. Special-use trails are also designed for particular types of users including young children and those persons who are physically handicapped. Such trails provide people of varying ages and physical conditions opportunities for nature study²⁹.

Educational Structures. Educational structures are fundamental to an effective educational program. The structures may serve as the orientation center to the nature preserve and the educational program, headquarters for the staff, place of shelter during inclement weather, and may also provide space for educational facilities such as libraries and workshops.

Some nature study preserves do not have an educational structure on the site; others contain extensive educational structures. An illustration of the latter is the educational structure at Fernbank Science Center in DeKalb County, Georgia. The structure contains an observatory, planetarium, natural history museum, auditorium, conference and seminar rooms, and individual research laboratories for experimental work³⁰. These facilities reflect the broad educational program proposed for this nature study preserve.

Parking Facilities. Facilities for parking vehicles are necessary incidental improvements for nature study preserves. Nature preserves

serve large geographic areas; therefore, parking accommodations are required on or near nature preserves.

Parking facilities are usually located near entrances to preserves or near educational structures. The Arizona-Sonora Desert Museum near Tucson, Arizona, has its parking area at the entrance to the preserve³¹. Parking areas are located off a loop drive which passes in front of the museum building and planetarium at the Stamford Museum and Nature Center in Stamford, Connecticut³². The parking facilities of the West Rock Nature Recreation Center at New Haven, Connecticut, are located on the opposite side of the street from the preserve site³³.

Parking accommodations for buses are required if the educational programs of nature study preserves involve the participation of students from schools beyond walking distances. The West Rock Nature Recreation Center, noted above, is one preserve which provides separate parking facilities for buses³⁴.

CHAPTER III

PLANNING FOR NATURE STUDY PRESERVES

Planning for nature study preserves in urban areas should be done in a methodical manner. Initially, the educational program should be developed. Then, a proper location should be selected for the nature study preserve, and lastly, a site development plan should be prepared. This chapter discusses these factors and suggests procedures to be followed in planning for nature study preserves.

Educational Program

The educational program for the nature study preserve should be developed in order that the needs of the program can be considered in the location and site selection of the preserve. The educational program should be designed to supplement educational and recreational activities which can be enhanced by outdoor experiences in the preserve.

In developing the educational program for the natural forest at the Fernbank Science Center in Metropolitan Atlanta, science course guides for DeKalb County Schools and the State of Georgia were reviewed for adaptability to a program in the forest. This review revealed that the science curriculum in all elementary grades could be enhanced by the forest program. In addition, it was determined that general and physical science, biology, chemistry, and physics at the secondary level could be benefited. Teacher guides for different grades and subjects were prepared by the professional staff of the Center and reviewed by an advisory board

consisting of professionals and lay citizens³⁵.

The educational program of the Nature Study Area of Salisbury, North Carolina, was developed somewhat differently. Conferences were held with teachers and administrators of the participating schools and colleges to explore possible educational uses of the natural area. Consultants and specialists in the fields of study considered, including a team from the National Audubon Society, were called upon for advice. Professional staff members visited other nature study areas and conferred with numerous persons in the related fields³⁶.

Programs of adult education and recreation should also be surveyed to determine whether the nature study preserve can be employed to advantage. Local conservation and recreation organizations and members of such national groups as the Izaak Walton League of America, Inc.^{*}, American Nature Study Society^{**}, Association of Interpretive Naturalists^{***}, and National Audubon Society should be approached concerning their interests in the nature study preserve.

In addition to developing a program to supplement existing educational and recreational courses and programs, research should be undertaken to identify new programs for the nature study preserve. Such research should include a review of literature on nature study and conservation, an inquiry into proposed courses of study and programs at the

* Izaak Walton League of America, 1326 Waukegan Road, Glenview, Illinois, 60025.

** American Nature Study Society, RFD, Homer, New York.

*** Association of Interpretive Naturalists, 5956 North Hadadorn Road, East Lansing, Michigan, 48823.

national and state levels, and an evaluation of other community programs on nature study for possible application locally. Experimental or pilot programs might very well lead to new and expanded programs for the nature study preserve.

Estimates should be made of the number of persons expected to participate in the program of a nature study preserve. Students of educational institutions constitute the largest group of participants in the educational programs of nature preserves. Conservation and recreation groups also participate, but these groups usually participate on the weekend, while students participate during the week. Since student participation in the program of a preserve is the largest, and the periods of use differ between the students of educational institutions and other groups, the participation of students should be the important factor in estimating the participation in a preserve program.

First, long-range projections of future population and its location, as prepared by most planning departments, should be used to identify desirable locations of sites for nature study preserves. The projected amount of population will indicate the long-range demands on a nature study program. The geographic distribution of the projected population is useful in determining the number and location of preserve sites. In large urban areas the distribution of population might warrant a system of preserve sites rather than a single site, owing to excessive travel time from distant schools or to the over-saturation of a single site.

Second, present and projected student participation in the preserve program should be determined. Educational officials should be consulted. Records of past enrollment by grades and subjects are usually

maintained for school systems and institutions of higher education, as well as projections of enrollment for 5- to 10-year periods. In this regard, it is particularly important to evaluate possible trends in the participation of courses related to nature study, such as general science, biology, and physical science. These trends might differ from overall enrollment figures and thereby indicate a greater or lesser participation in a nature study program, thus derived, for a period of 5 to 10 years should be used to determine the initial need for improvements, such as educational structures, nature trails, and parking facilities.

Locational Considerations

In locating nature study preserves, consideration should be given to the site requirements, accessibility to educational institutions, adjoining land use, transportation, and utilities.

Site Requirements

Site requirements of nature study preserves in urban areas are the most important locational factors. The specific site requirements of a preserve are based upon the scope of the educational program and the expected participation. General site requirements, such as the desirability of virgin forest and water on site, impose substantial limitations to the location of nature study preserves in urban areas. The site factors which most often influence the location of nature study preserves are the land characteristics, site acreage and shape, and land ownership patterns.

Land Characteristics. Land selected for nature study preserves should be representative of the native landscape. It should be reasonably undeveloped, include a variety of relief and natural features, and contain

water in the form of a branch, pond, or lake. To illustrate, preserves in the eastern United States should include features such as dense forests, fields, marshes, and streams³⁷. Land of this character not only provides heterogeneous physical features but the diversity of habitat necessary to accommodate a variety of plants and animals.

Important questions to be raised with respect to land being considered for nature study preserves include:

What are its features? What does it have to offer? Is any part of this land characteristic or reminiscent of early America? Does any part of the land reflect the historic growth of the countryside, perhaps the transition from wood-land or prairie to farming? Has the tract any special natural features--a brook, river, pond, or small lake? Does it have a cliff or an outcrop of rock that exposes several different formations? What kinds of trees are represented in the forests or woods? What kinds of plants are found in the meadow or prairie? What are the characteristics of its soils? What about the surviving population of birds and animals³⁸?

Site Acreage and Shape. The acreage required for a particular nature study preserve should be governed by long-range population projections. Sufficient area should be obtained to accommodate the facilities required for the future educational program plus parking facilities for automobiles and buses bringing visitors to the preserve. In determining the site acreage it is better to establish a site a size larger than needed than to select an acreage which will be inadequate to meet future needs.

The Nature Centers Division of the National Audubon Society suggests that a nature study area should contain a minimum of 50 acres for the most limited nature study program³⁹. Sites with rough topography or other conditions making it difficult to develop with trails and structures require larger acreages. There is no maximum acreage for a preserve, and some

preserves contain hundreds of acres. Special features, such as soil management areas, forest management areas, day camps, and additional hinterland for wildlife preservation require acreage substantially above the minimum area.

The forest program at Fernbank Science Center in DeKalb County, Georgia, serves the population of Metropolitan Atlanta of one and a quarter million on less than a 75-acre site. Visitors approached 10,000 per month during the spring months of 1967 and the number is expected to increase to 12,000-14,000 per month in the coming year, its second year of operation. However, the educational program does not include the use of soil management areas, forest management areas, or other conservation demonstration areas which demand large acreages⁴⁰. (See Appendix III.)

While the shape of the site is not an over-riding consideration, a site that provides approximately equal width and depth has the advantages of flexibility in development of nature trails and affords land area for interior buffer strips from the adjoining development, if needed. The director on one preserve expressed dissatisfaction with the long, narrow shape of his forest area because it did not provide adequate isolation for wildlife habitat⁴¹.

Land Ownership. The land ownership patterns may be an important factor owing to the large acreage required for nature study preserves. Land in a single ownership provides ease of acquisition. Greater time and effort are required to negotiate the purchase of a site at a reasonable price from a group of owners. However, frequently in urban areas large undeveloped parcels of land are in joint or separate ownership by

several persons. If such be the case, one or more owners may hold out for an excessive price for his land following the agreement to sell by the remaining owners. While public bodies can use the power of eminent domain to obtain the properties of owners who are reluctant to sell, the process of condemning property is in itself time consuming and expensive. Consequently, a minimum number of parcels of land is desirable when purchasing sites for nature study preserves.

Accessibility to Educational Institutions

Where several sites are available, a nature study preserve should be located as accessible as possible to the majority of educational institutions it serves. Students of public schools and institutions of higher education are the primary users of preserves during academic days. Since the student visits to preserves are from the schools, accessibility to the educational institutions should be a heavy factor in the location of preserves. The convenience afforded the students is beneficial. Also, locations near educational facilities provide the opportunity, if desired, for the educational program to operate out of the adjacent educational institution.

Adjoining Land Use

Nature study preserves should be located near compatible land uses such as wetlands, lakes, parks, golf courses, and low density residences. Such uses provide area outside of the preserve for wildlife habitat and plant life. Thus, the potential is increased for greater variety of plants and animals at the preserve. Reciprocally, the open space character of nature study preserves enhances the attractiveness of adjoining residential and recreational land uses. Nature study preserves

should not be located adjoining large commercial and industrial areas which might have adverse effect on the natural environment. Air and water pollution and excessive traffic and noise resulting from such uses would be harmful to the natural conditions desired for preserves.

Nature study preserves located in proximity to recreational facilities can expect to receive greater use than preserves without nearness to recreational facilities. For example, a nature study preserve located in or near a recreational park will attract some park visitors to the preserve. In addition, the proximity of the nature study preserve to recreational facilities affords convenience when friends or members of the family desire to participate in a variety of activities which are located near each other.

Transportation

Nature study preserves should be located where access to transportation facilities is easy. Travel time is reduced and newcomers are less likely to have problems finding nature study preserves located on or near major roadways and mass transit routes. Frequently, buses are used to transport students from schools to nature study preserves. Minor residential streets are difficult to negotiate with buses, and if the preserve is used extensively by patrons of buses or automobiles, the traffic may be detrimental to the adjoining residential development. Also, there is an advertising advantage derived from locating preserves on major traffic routes. The facility, if properly identified, can be brought to the attention of the traveling public. Therefore, the existing and future transportation system should be evaluated to assure easy accessibility to nature study preserves.

Utilities

The availability of electricity, sewerage facilities and public water supplies at nature study preserves is desirable. However, the area requirements of nature study preserves provide an opportunity for on-site water and sewerage facilities. Nevertheless, all locational factors being balanced, nature study preserves should be located where public utilities are available.

Site Development

Site development of nature study preserves should be predicated on a comprehensive site plan. The development plan is designed to meet the needs of the proposed educational program, and while development of the site in stages may be necessary, the site plan should be devised to accommodate the ultimate educational program. Of course, the natural features of the site should be used to their best advantage in the preparation of the site plan. In this connection, an experienced natural scientist should survey the site and identify pertinent natural phenomena. The principal design elements of nature study sites are the nature trails, educational structures, and parking facilities.

Nature Trails

Thorough familiarization with the natural phenomena of the nature study site is required to properly plan the nature trails of a preserve. It is recommended that a card file be prepared of all the assets and opportunities that the property yields in order that the advantages of the site may be utilized to their fullest extent⁴².

Nature trails should be winding, narrow in width except near

points of interest and at teaching stations, and short in length. While narrow and winding trails are most interesting, trails to be used by school groups should be four to six feet in width in order that the group may be kept together in an orderly manner. A half-mile is suggested for trail lengths. Trails should be designed as loops so that the visitor is not required to retrace his steps. Interconnecting trails are suggested⁴³.

Educational Structures

The accommodations of educational structures vary with the scope of the educational program of the nature study preserve. The Nature Centers Division of the National Audubon Society contends that a "well-planned" structure provides staff headquarters, a meeting room, a laboratory, a library, a workshop, a craft room, facilities for handicapped persons, toilet facilities, a sales store, storage space, and provision for expansion⁴⁴.

Educational structures usually serve as focal points for receiving and controlling visitors to the preserve. Therefore, a peripheral location in the vicinity of the major transportation access is desirable for the educational structure. Such a location provides easy access and permits the natural features in the interior of the site to remain undisturbed. Furthermore, it eliminates the need for roadways and pedestrianways into the heart of the nature study area.

Parking Facilities

The area requirements for parking facilities should be established from estimates of the number of persons expected to participate in the educational program and modes of transportation to be used by the parti-

cipants. Participation projections were discussed previously in this chapter. The modes of student transportation should be obtained from educational officials. If school or chartered buses are used to transport students from schools to preserve sites, as occurs frequently, the number of students per bus should be determined. Consideration should also be given to the overlapping demand for parking spaces required to accommodate waiting and arriving buses. Conversely, less parking area may be required if one bus is used to shuttle several classes to and from the preserve.

While student participation is usually the critical element in planning for parking at nature preserves, consideration should be given to the parking needs of individuals and conservation and recreation groups. Likewise, the parking needs of the preserve staff should be added to the parking requirements of participants.

Should parking for buses be the critical need during the week and parking for automobiles be critical on weekends, parking facilities might be developed to permit interchangeable use by automobiles and buses.

Parking facilities for motor vehicles should be located near the focal point of a preserve where visitors are controlled. Usually the focal point is the educational structure, and parking accommodations should be provided nearby. However, if the educational structure is in the interior of the preserve it would be advisable to locate parking facilities on the periphery to avoid disturbing the natural conditions of the site, unless the site were unusually large. Parking areas should also be located so as to provide easy traffic movement from access streets.

CHAPTER IV

THE AGENCY, STAFF AND FINANCIAL ASSISTANCE

This chapter discusses the types of agencies responsible for the administration of preserve programs, their staff requirements, and sources of government and private financial assistance available for the establishment and operation of nature study preserves.

The Agency

The administration of preserves includes the physical maintenance of the sites and the operation of educational programs. Nature study preserves may be the administrative responsibility of public agencies or private organizations.

Public Agencies

In most cases the ownership, maintenance, and operation of educational programs of preserves administered by public agencies are the responsibility of one agency. Existing local education and conservation-recreation agencies are generally responsible for the operation of nature study preserves. These agencies have the type resources needed to initiate and conduct nature study programs including potential pressure sites, capable staff, and access to financial resources. Only the program itself has to be established.

Education Agencies. The educational programs of nature study preserves are logical links with local educational systems. Fernbank Science Center which serves Metropolitan Atlanta, Georgia, is an example of a

nature study area administered by an educational agency, the DeKalb County Board of Education⁴⁵. Likewise, the Nature Study Area of Salisbury, North Carolina, is administered by the City School Board⁴⁶.

A survey by the Nature Conservancy* in 1962 indicated that more than one hundred colleges maintained natural areas for teaching and ecological research. Further, the survey revealed that, while some of the natural areas were supervised by special committees of persons from different departments of the college, in most instances, the biology departments were responsible for the preserves⁴⁷.

Conservation-Recreation Agencies. Conservation-recreation agencies are also well suited to administer nature study preserves. The Columbus Metropolitan Park Board of Ohio provides park lands for all the citizens of the Columbus Metropolitan Area. A wide range of activities is conducted by the Board including nature study programs at three outdoor education and nature centers. The Ohio Park District Law, under which the Board operates, permits the Park Board to acquire land for the preservation of recreational resources consisting primarily of woodlands, streams, lakes, swamps, and submerged lands⁴⁸. Obviously, lands of this character are desirable for nature study preserves.

Another example of a conservation-recreation agency that is responsible for the administration of nature study preserves is the Forest Preserve District of Cook County, Illinois. Several nature centers are operated by the District in the forty-two thousand acres of forest preserve which practically encircle the City of Chicago. The state enabling

*The Nature Conservancy, 1522 K Street, N. W., Washington, D. C., 20006.

law grants the district the authority to maintain and preserve the forest lands together with their flora and fauna in their natural condition for the education, recreation, and enjoyment of the citizens of the area⁴⁹. Thus, the enabling legislation includes provisions for the administration of nature study programs.

Private Organizations

Private organizations responsible for nature study preserves include local non-profit associations and national conservation organizations. The advantage of these independent agencies, local or national, is that they can initiate programs which governmental agencies fail to recognize as important. Frequently, the responsibility of such endeavors are eventually assumed by governmental agencies. Also, individuals or groups are more willing to donate funds to private organizations than to governmental agencies.

Local Associations. Local citizens or civic organizations may incorporate and assume the responsibilities of administering a nature study preserve. The Nature Museum of Charlotte, North Carolina, is an example. Authority for administering the Museum is vested in a Board of Directors which is composed of interested citizens of the community. The idea of the Charlotte Museum was initiated by one individual and gained support from the Junior League and other civic groups and community leaders until it was incorporated in 1948⁵⁰.

The Merton Arboretum in the Metropolitan Chicago area is another example of a nature study area owned and operated by a local private organization. The Arboretum is directed by a Board of Trustees⁵¹.

National Organizations. National conservation organizations main-

tain some nature study preserves. The National Audubon Society and the Natural Science for Youth Foundation are two such organizations. These organizations administer nature preserves as demonstration projects and generally are not interested in assuming the administrative responsibility of additional nature areas.

The National Audubon Society, in addition to promoting local nature center associations, is responsible for several nature study programs and sites. (See Appendix IV for a list of the nature centers and farms operated by the National Audubon Society.) The Society is supported wholly by private funds derived through memberships and gifts. The Audubon Center of Southern California, located in El Monte, California, was established by the Society in 1939. Other nature centers are operated by the National Audubon Society in the states of New Jersey, California, Ohio, and Connecticut⁵².

The Natural Science for Youth Foundation, formerly the William T. Hornaday Memorial Foundation, was established to stimulate, guide, and assist local communities in the development of natural science centers and nature museums. However, in recent years the Foundation has initiated a regional program which features the development and operation of model centers in each section of the United States⁵³. A model center for the Midwest was recently completed in Kalamazoo, Michigan, and it is recognized as one of the most outstanding centers in the nation⁵⁴.

The Staff

The staff required to operate a nature study preserve depends upon the magnitude of the educational program and the number of persons

participating therein. It has been suggested that a staff of three people, a director, caretaker, and clerk-typist is required for the minimum endeavor⁵⁵. However, most nature study preserves maintain a larger staff than indicated above. In fact, the Fernbank Science Center employs forty-three persons⁵⁶.

This section briefly describes the basic professional and non-professional personnel required to administer a typical nature study preserve.

Professional

The professional staff is usually composed of a director and instructors.

Director. The director is the administrative head of the nature study program, reporting to a school board, a board of trustees, or other governing body. He must be a capable executive as he is responsible for operating the nature study programs and the preserve site. His duties include cooperating with schools and civic organizations, working with the visiting public, operating the preserve on an annual budget, planning for future educational programs and developing the preserve. In smaller nature study programs, the director may be required to teach and prepare lesson plans, exhibits, as well as administer the programs and maintain the site.

College training in conservation or the natural sciences, teaching skills, and administrative experience are desirable for the director of a nature study program.

Instructors. The number and skills of the instructors of nature study preserves depend upon the educational program and the number of

participants. College degrees in biology, botany, zoology, horticulture, and geology, with some teaching experience, are desirable qualifications for the instructors. Since most of the teaching is conducted out-of-doors, persons with experience in field interpretation of nature easily adapt to instructing positions in preserve programs. Ability to develop instructional material and programs for all age groups is required.

Nonprofessional

The nonprofessional staff consists of secretarial and maintenance personnel.

Secretarial Personnel. Clerical and administrative assistance, including the typing of correspondence, maintaining records, and preparing materials for publication, are required of secretarial personnel by the director of a preserve. Likewise, secretarial personnel assist instructors with their administrative responsibilities. In small nature study programs secretarial personnel might be responsible for maintaining the library, performing limited research for the professional staff, and the like. Secretaries with experience in educational institutions are desirable for preserve secretarial personnel.

Maintenance Personnel. The maintenance personnel include caretakers of the structures, nature trails, and parking areas. Some nature study programs, such as the one underway at Fernbank Science Center in Metropolitan Atlanta, require well educated and skilled maintenance personnel. The caretaker of the Fernbank program is responsible for the future development of the grounds and the supervision of limited restoration of native plants, and his duties require experience as well as a minimum of a Bachelor of Science Degree in botany, horticulture, or forestry⁵⁷.

Financial Assistance

Federal, state, and private financial assistance is available to local communities for the planning, acquisition, development, and operation of nature study preserves.

Federal

The Federal Government provides grants and loans for purchasing and developing nature study preserves and for financing nature study programs.

Federal agencies administering these financial assistance programs include the Department of Housing and Urban Development, Department of Health, Education and Welfare, and the Department of Interior.

Department of Housing and Urban Development. The Department of Housing and Urban Development is responsible for three programs of financial assistance in the acquisition and development of nature study preserves. These programs are administered under the Housing and Urban Development Act of 1965.

1. Title IX, Open-Space Land and Urban Beautification and Improvement, provides local governments up to 50 percent of the cost of acquiring land for preserves. Also, 50 percent financial assistance is available to assist in developing the acquired land with nature trails and trail-side demonstrations and displays. Chiwaukee Prairie, a 63-acre native prairie, was recently purchased under this program for special scientific study by the University of Wisconsin⁵⁸.

2. Interest-free advances for project planning of nature study sites and facilities are available through Title XI, Section 1104, Public Works Planning Advances. Local public agencies are eligible for the ad-

vances. Repayment is required upon the start of construction of the nature study facilities.

3. Title XI, Section 1107, Public Facility Loans, provides long-term loans (up to forty years) to local governments for the construction of the structures and trails of a nature study area. Unless the community is near a research or development installation of the National Aeronautics and Space Agency or in a redevelopment area designed by the Economic Development Administration, the population of the community must be under 50,000 to be eligible for these loans⁵⁹.

Department of Health, Education and Welfare. Under the authority of the "Elementary and Secondary Education Act of 1965," the Department of Health, Education and Welfare administers two programs of financial assistance for nature study programs and related facilities and equipment.

1. Title I of the Act provides financial assistance to local educational agencies for special educational programs in areas having high concentrations of educationally disadvantaged children. The funds can be used to hire additional staff, acquire equipment and construct facilities. State educational agencies are responsible for the program, and the funds available to local school districts would depend upon the average expenditure per school child in the state and the number of school-age children in the district from families with low annual incomes⁶⁰. While these funds can be used for nature study programs, none could be identified as having been allocated for said purpose at the present.

2. Title III of the Act authorizes a program of grants for supplementary educational centers such as nature study preserves. Grants may be made for the construction of facilities, acquisition of equipment, and

operational expenses including staffing and expendable items. The allocation of the funds to the state is based on a formula involving the school-age population and the total population of the entire state. State educational agencies review and make recommendations on the application of local educational agencies before submittal to the Department of Health, Education and Welfare⁶¹. At least two nature study programs are receiving funds under this title, Salisbury Nature Study Area in Salisbury, North Carolina, and Fernbank Science Center in Atlanta, Georgia⁶².

Department of Interior. The Department of Interior has a program of financial assistance for the acquisition and development of nature study preserves. It was made possible by the enactment of the Land and Water Conservation Fund Act of 1965. The funds, which are derived from entrance and user fees at designated Federal Recreational areas, from the sale of federal surplus real property, from the federal tax on motorboat fuels and initially from advance appropriations, are available through state agencies responsible for outdoor recreation resources. Appropriate local agencies may obtain funds on a 50-50 matching basis for the acquisition of land and the development of structures and trails for nature study preserves⁶³.

State

New York, Pennsylvania, Connecticut, and New Jersey have programs which provide grants-in-aid to communities for the acquisition of open space, including sites for nature study preserves. However, none of these state programs of aid to communities provide assistance for development or operation of acquired areas.

New York. The State of New York allocated to local governments one-half of an authorized \$100 million for the acquisition of open and natural lands. Under the program local governments are eligible for up to 75 percent of the land acquisition costs. Eighty percent of the land acquired by State or local governments must be in or near urban areas. Thus, the program focuses on the need for preserving the scenery and natural resources of the urban areas and provides incentive for local governments to take action to meet their open space needs⁶⁴.

Pennsylvania. Pennsylvania's "Project 70" is a land acquisition program designed to expend \$70 million by 1970 for open space. This acquisition program, like the New York program, is urban-oriented. The program is being financed by State bonds, and \$20 million of the \$70 million have been allocated to local governments for 50 percent matching funds to acquire open space⁶⁵.

Connecticut. In July, 1963, the State of Connecticut, with the adoption of an open space grant-in-aid act initiated a program to preserve areas for conservation, wildlife, recreation, and other open space purposes. Three million dollars were provided to aid local governments in the acquisition of lands through grants of up to 50 percent of the non-federal share of the cost⁶⁶.

New Jersey. The voters of New Jersey endorsed a \$60 million Green Areas Bond Act in November of 1961. Under the Act, land may be acquired for parks, natural areas, forest, and similar recreation or conservation activities. Twenty million dollars are to be used for matching grants to local governments of 50 percent of the land acquisition costs⁶⁷.

Private

Private organizations and individuals provide financial assistance for the planning, establishment, and operation of nature study preserves.

The Division of Nature Centers of the National Audubon Society shares the cost of providing professional field services, such as feasibility studies and comprehensive surveys and plans for nature preserves and programs⁶⁸.

The Nature Conservancy, a membership organization with state chapters, is dedicated to the preservation of natural areas. It provides counsel and temporary financial assistance through a revolving loan fund⁶⁹.

Philanthropic citizens have provided land and financial assistance for nature study preserves. For example, Mrs. John W. Aull donated 70 acres of farmland for the establishment of a nature center near Dayton, Ohio. She also provided funds to get the project underway and established a trust fund which presently brings in approximately \$15,000 yearly for operating expenses⁷⁰.

Frequently, local financial assistance for nature study preserves is derived from a combination of sources both governmental and private. The Nature Museum of Charlotte, North Carolina, has a site provided by the Park Association, an affiliate of the Lion's Club. The Junior League and other civic organizations financed the museum building. Its operation and further development are financed jointly by the United Arts Council, Inc., the City of Charlotte and the County of Mecklenburg⁷¹.

The benefits of nature study preserves in urban areas are numerous. The educational experiences in nature and conservation afforded by nearby

preserves produce more enlightened citizenry. The recreational opportunities provided by nature preserves are important and will become more important if the participation trends in nature-related recreation, such as camping and hiking continue. In addition, nature study preserves provide open space in areas of urban development.

The demand for nature preserves in urban areas will increase as recognition of their attributes becomes widespread. Proper planning steps should be taken to assure the urban populations an opportunity to participate in the nature study programs of preserves.

APPENDICES

APPENDIX I

NUMBER OF NATURAL SCIENCE CENTERS, NATURE MUSEUMS,
AND TRAILSIDE MUSEUMS BY STATES, 1964-1965*

State	Number
Arizona	1
California	20
Colorado	1
Connecticut	16
District of Columbia	1
Florida	13
Georgia	6
Hawaii	1
Illinois	7
Indiana	4
Louisiana	1
Maryland	3
Massachusetts	22
Michigan	6
Minnesota	2
Missouri	1
New Hampshire	1
New Jersey	10
New Mexico	1
New York	22
North Carolina	6
Ohio	13
Oregon	1
Pennsylvania	7
Rhode Island	2
South Carolina	2
Tennessee	3
Texas	6
Virginia	3
West Virginia	2
Wisconsin	2
Total:	186

* Natural Science for Youth Foundation. 1964-1965 Listing of Natural Science Centers Nature Museums and Trailside Museums. New York: The Foundation, 1965.

APPENDIX II

EXCERPTS FROM THE PROPOSED EDUCATIONAL PROGRAM FOR
SALISBURY NATURE STUDY AREA*

Specific programs have been developed pertaining to nature study, nature science, local and regional history, space science, and visual fine arts.

All of the programs are correlated with and should enrich our present school curriculum. The purpose of the programs will be to provide teachers and pupils unusual experiences, not practical in the traditional classroom, and to enrich the present curriculum.

Old patterns of school organization are no longer adequate to cope with the enormous growth in school population and knowledge. We need to attack the old patterns with vigorous new solutions. The Center should help us to do this.

Proposed Nature Study and Natural Science Program

Nature studies will be conducted in a natural area rich in local flora and fauna. The area contains varying land forms: of hill sides, swamps, and meadow. Nature trails, wooden swamp walks and outdoor classroom facilities are already available. Learning that stems from direct contact with nature arouses more interest and curiosity and makes the desire to know more lasting and significant. Outdoor education is as

* Salisbury City Board of Education. Application for Operational Grant and for Renovation, Remodeling, and Construction Facilities Grant, Elementary and Secondary Act of 1965, Title III, (P.L. 89-10) for a Supplementary Education Center. Salisbury, North Carolina: The Board, January 13, 1967, pp. 10-11 (typed).

old as mankind. Its "curriculum" is without limits. Its use should be intensified and encouraged.

Educational Programs by Grade Levels K-12

Conservation theme to be used in all areas:

Grades K-2	Seeds in Nature Flowers Animal Babies Birds Soil Plant Structure Food Cycles
Grades 3-4	Insects in General Social Insects Insect Homes Seed Travel Seed Structure Desert Animals Marine Animals Moon and Planets Stars and Constellations
Grades 5-6	Molds, Mushrooms, Lichens Mosses and Ferns Wild Flowers Soil Conservation Rocks and Minerals Marine Animals Food Chains
Grades 7-8	Nature Studies Adaptations of Life Living Things in Their Environment Successions Meteorology Rocks and Minerals
Grades 9-10	Space Science Classification of Plants and Animals Botany Ecology
Grades 11-12	Ecology Plant and Animal Communities

Subject area selection is based to some extent on the emphasis given in

textbooks in grades one through twelve but new concepts and areas of study are presented.

Proposed Local and Regional History Program

Rowan and Davie Counties have a rich heritage in history but few of our pupils and adults are fully aware of this heritage. A great majority of our children have never had the opportunity to visit the historical sites in the area. Textbook oriented teaching needs to be enriched to arouse interest in local history. Two historical landmarks are available on the site: a one-room log school house (Setzer School), dating from 1842, and a Chilean ore mill once used in the 19th century gold mining industry at Gold Hill in Rowan County. The history portion of our program will probably start on the fifth, seventh, and eleventh grade levels because more attention is given to the United States including North Carolina, in these grades.

Proposed Space Science Laboratory

The space science laboratory will be supplementary audio-visual aid to reinforce classroom teaching (not to replace classroom teaching) and pupil learning. Owned and operated by the Salisbury City Board of Education as part of the Supplementary Educational Center, the facility will be devoted to education and will not be used to conduct "shows." As an audio-visual aid, the facility will not be an end in itself but wisely used in coordination with traditional classroom studies to provide an excellent program involving hundreds of individuals each year.

The curvature and three dimensions of the laboratory will aid the teacher in demonstrating concepts virtually impossible in the flat-sided classroom. The spectacular achievements in the United States space ex-

ploration programs have provided the stimulus for pupils to become more interested in rockets, space travel, satellite communication, and astronomy. A visit to the space science laboratory will supplement as well as augment pupil studies in space science, and will make possible the teaching of space science in a controlled environment that is not blurred or distorted by street lights, smoke, smog, and adverse weather conditions. Phenomena which require centuries in nature to occur can be accomplished within a single class period.

Adult programs will emphasize the same educational objectives. Special seasonal programs for the communities at large will stimulate a deeper and more lasting appreciation of our universe.

An observatory on the adjacent campus of Catawba College will be used in conjunction with space science activities and units of work. The observatory is currently being used by our local exploratory programs in the summer months.

Proposed Visual Arts

Fine arts (visual) is probably the area of our present school curriculum most in need of improvement. Too often art activities are merely mechanical or routine. Art activities pertaining to the observation, appreciation, and creation of beauty for the purpose of cultural enrichment will be explored and emphasized in the program of the Center. The visual arts program will be oriented to the recommended course of study of the North Carolina Department of Public Instruction.

Priorities for the visual art program - Grades K-12:

1. To provide opportunities to display children's work in an exhibit area.

2. To enhance teacher interest and skills in directing art experience in many media.

3. To demonstrate techniques in various media for teachers and others.

4. To give students experience in drawing, painting, sculpture, ceramics, and molding.

5. To provide exhibit facilities for local and traveling art collections.

General adult educational programs will also be provided in nature study, natural science, local and regional history, and space science, based on interest and participation.

APPENDIX III

EXCERPTS FROM CURRICULUM OUTLINES FOR
EDUCATIONAL PROGRAM AT FERNBANK SCIENCE CENTER *Standard Elementary CurriculumsField Ecology (Second Grade)

- I. Introduction to Fernbank Forest
 - A. Brief history
 - B. Rules governing use of forest
- II. Discussion of the likenesses and differences between plants and animals
 - A. Plants and animals have common needs
 - 1. Plants and animals are alive
 - 2. All living things need water, oxygen, light, and food
 - B. No two living things are exactly alike
 - 1. Observation of the variations among living things
 - 2. The differences within and between different plants and animal groups
 - 3. Observations and discussion pertaining to the reasons why scientists put in individual groups those animals or plants that have similar functions and structures.
- III. Plants and animals need each other
- IV. A community which loses any one or more of the above living things loses its balance

Field Ecology (Fourth Grade)

- I. Introduction to Fernbank Forest

* DeKalb County Board of Education, Fernbank Science Center, DeKalb County, Georgia. Fernbank Forest Teacher's Guide. Georgia: The Center, 1967.

II. The Forest

- A. Observation and discussion of living organisms
- B. Observation and discussion of non-living (physical) elements
- C. Study of relationships involved between the living and non-living components within the forest
- D. "Balance" as a concept within the forest

III. Plants in the forest

- A. General observation of plant structure
- B. Life functions related to specific plant parts
- C. Factors influencing growth and distribution of plants
 - 1. Physical factors
 - 2. Observation of habitats
- D. Identification by common names of conspicuous plant life

IV. Animals in the forest

- V. Relationships involved among plants and animals

VI. Conservation as a way of life

VII. Review and evaluation

Field Ecology (Sixth Grade)

I. Introduction to Fernbank Forest

II. The forest as an ecosystem

- A. Illustration of ecosystem
- B. Representative environmental factors
- C. "Balance" within the ecosystem

III. Inter-relationships among plants and animals

- A. Nutritional relationships
 - 1. Food chains and webs

- 2. Interspecific organism relationships
- B. Ecological relationships
- IV. Study of the plant community
 - A. Primary succession (Elephant Rock)
 - 1. Biotic elements present
 - 2. Abiotic elements present
 - B. Pond succession
 - 1. Biotic elements present
 - 2. Influential abiotic elements
 - 3. Food chains and webs
 - C. Secondary succession
 - 1. Biotic elements present
 - 2. Abiotic elements
- V. "Ecological" conservation

Plant Taxonomy (Sixth Grade)

- I. Plant taxonomy - the "family tree" of living things
 - A. Characteristics of living things
 - B. Basic criteria for classification
- II. Classification within the plant kingdom
 - A. Vascular plants: the Tracheophytes
 - 1. Angiosperms
 - 2. Gymnosperms
 - 3. The Ferns
 - B. Novascular plants
 - 1. The Bryophytes
 - 2. The Fungi
- III. General review

Specialized Elementary Curriculums

Introduction to Ornithology

- I. Learning to identify some of the area's common birds through sight and song.
- II. Observing the food and nesting habits of various species.
- III. Observing the various adaptations present among different species of birds which afford each its own ecological niche, such as beak design that enables the particular organism to eat different kinds of food, feet constructed in particular designs, each adapting individual birds to different walking, perching, and food searching habits.
- IV. Listening and identifying particular bird songs and calls.

Conservation

- I. Conservation and the forest
 - A. Discussion of meaning of conservation
 - B. Introduction to concept involving an ecological approach to conservation
 1. Distinction between ecology and conservation
 2. Interacting relationships involved in ecology and conservation
- II. Ecological guidelines for conservation
 - A. Adaptation of plants and animals to abiotic environment
 1. Physical factors
 2. Observation of some adjustments by living organisms to the physical environment
 - B. Adaptation of plants and animals to biotic environment
 1. Concept of "ecological niche"

- 2. Presence of food chains and food webs
- III. Functional conservation through ecology
 - A. Ecological ramifications of forest land conservation
 - B. Discussion of possible disturbances which may occur in the forest
 - C. Discussion of consequences to total ecosystem as a result of disturbances
 - D. Importance of conservation of forest to man.

Standard Secondary Curriculum

Field Ecology

- I. Introduction to ecology
- II. Succession
 - A. Disturbed area-old field succession
 - 1. Relief and elevation of area
 - 2. Representative organisms
 - B. Secondary climax area
 - 1. Relief and elevation of area
 - 2. Representative organisms
 - C. Climax area
 - 1. Relief and elevation
 - 2. Representative organisms
- III. Specific areas for ecological study
 - A. Microcommunity
 - 1. Elephant Rock
 - 2. Fallen tree-log community
 - B. Ecosystem

1. Pond ecosystem
2. Forest ecosystem

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Plant Taxonomy

I. Introduction to taxonomy

A. History

1. Ancient Greeks and Romans
2. The Herbalists
3. The transition period
4. The modern period

B. The Binomial system and its importance

II. Classification of major divisions of Fernbank Forest Flora

A. Mycophyta

1. Class Basidiomycetes
2. Class Ascomycetes

B. Bryophyta

1. Class Hepaticae
2. Class Musci

C. Tracheophyta

1. Subphylum Lycopsidea
2. Subphylum Pteropsida

Specialized Secondary Curriculums

Winter Taxonomy of Plants

I. Introduction to winter taxonomy of deciduous trees and shrubs.

A. Terminology of twig structures

1. Leaf buds
2. Leaf scars
3. Stipule scars
4. Bud scale scars

- 5. Lenticels
 - 6. Thorns and spines
 - 7. Composition and shape of the pith
 - 8. Twig surfaces
 - 9. Cross-section of twigs
 - B. Terminology of fruit types
 - 1. Compound
 - 2. Simple
- II. Identification of deciduous trees and shrubs (winter structures)
- A. Arrangement of leaf scars
 - 1. Opposite
 - 2. Alternate
 - B. Number of bundle scars
 - 1. Four to many with opposite leaf scars
 - 2. One to three with opposite leaf scars
 - 3. Four to many with alternate leaf scars
 - 4. Three with alternate leaf scars
 - 5. One with alternate leaf scars
 - C. Presence of thorns
 - 1. Thorns long and slender
 - 2. Thorns short and stout
- III. Identification of deciduous trees and shrubs (fruits)
- A. Compound fruits
 - 1. Multiple
 - 2. Aggregate
 - B. Simple fruits
 - 1. Fleshy
 - 2. Dry

Climax Forest Succession

- I. Effects of climate and soil on a regional climax
 - A. Climatic factors
 - B. Factors determining soil type
- II. The eastern deciduous forest province
 - A. General boundaries
 - B. Divisions of southern portion
 - 1. Oak-hickory forest
 - 2. Pinelands
 - 3. Magnolia maritime forest
 - C. Fernbank forest
 - 1. Patterns of growth
 - 2. Climax portion
 - 3. Secondary succession portion
 - 4. Surviving American chestnuts

APPENDIX IV

NATURE CENTERS AND DEMONSTRATION FARM OPERATED
BY THE NATIONAL AUDUBON SOCIETY*

Audubon Center of Greenwich
613 Riversville Road
Greenwich, Connecticut

Audubon Center of Northern California
376 Tiburon Boulevard
Tiburon, California

Audubon Center of Southern California
1000 North Durfee Avenue
El Monte, California

Aullwood Audubon Center
1000 Aullwood Road
Dayton, Ohio

Aullwood Children's Farm
9101 Frederick Road
Dayton, Ohio

Sharon Audubon Center
Route 4
Sharon, Connecticut

Stony Ford Sanctuary
Fretty Brook Road
Princeton, New Jersey

* Ashbaugh, Byron L., Trail Planning and Layout, New York: Nature Centers Division, National Audubon Society, 1965, p. 11.

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